Proposed Registration Document PRD2013-22

Hydrogen Peroxide

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Publications
Pest Management Regulatory Agency
Health Canada
2720 Riverside Drive
A.L. 6604-E2
Ottawa, Ontario K1A 0K9

Internet: pmra.publications@hc-sc.gc.ca
healthcanada.gc.ca/pmra
Facsimile: 613-736-3758
Information Service:
1-800-267-6315 or 613-736-3799
pmra.infoserv@hc-sc.gc.ca

Canada

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Table of Contents

Overview 1
Proposed Registration Decision for Hydrogen Peroxide 1
What Does Health Canada Consider When Making a Registration Decision? 2
What Is Hydrogen Peroxide? 2
Health Considerations 3
Environmental Considerations 4
Value Considerations 5
Measures to Minimize Risk 5
Next Steps 6
Other Information 6
Science Evaluation 7
1.0 The Active Ingredient, Its Properties and Uses 7
1.1 Directions for Use 7
1.2 Mode of Action 7
2.0 Methods of Analysis 7
3.0 Impact on Human and Animal Health 7
4.0 Impact on the Environment 7
4.1 Effects on Terrestrial Organisms 8
4.1.1 Terrestrial Vascular Plants 8
4.2.1 Risks to Terrestrial Organisms 8
5.0 Value 9
5.1 Effectiveness Against Pests 9
5.2 Non-Safety Adverse Effects 9
5.3 Economics 9
5.4 Sustainability 10
5.4.1 Survey of Alternatives 10
5.4.2 Compatibility with Current Management Practices Including Integrated Pest Management 10
5.4.3 Information on the Occurrence or Possible Occurrence of the Development of Resistance 10
5.4.4 Contribution to Risk Reduction and Sustainability 10
6.0 Pest Control Product Policy Considerations 10
7.0 Summary 11
7.1 Human Health and Safety 11
7.2 Environmental Risk 11
7.3 Value 11
8.0 Proposed Regulatory Decision 12

List of Abbreviations 13
Appendix I Tables and Figures 15
Table 1 Toxicity to Non-Target Species 15
Table 2 Screening Level Risk Assessment on Non-target Species 15
Table 3 Refined Risk Assessment on Non-Target Species 15
Table 4 Summary of Pest Control Alternatives for the Uses Supported on Greenhouse Surfaces with ZeroTol Broad-Spectrum Algaecide/Fungicide 16
Table 5 Summary of Fungicide Alternatives for the Uses Supported with ZeroTol Broad-Spectrum Algaecide/Fungicide* 16
Table 6 Use (label) Claims Proposed by Applicant and Whether Acceptable or Unsupported 18
References 21

Overview

Proposed Registration Decision for Hydrogen Peroxide

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing full registration for the sale and use of BioSafe M-70 Hydrogen Peroxide Technical Bactericide/Fungicide and ZeroTol Broad-Spectrum Algaecide/Fungicide, containing the technical grade active ingredient hydrogen peroxide, to control or prevent the buildup of fungi and algae on surfaces of greenhouse equipment and within the greenhouse irrigation waters, for the control of agricultural diseases, including rhizoctonia aerial blight, fusarium leaf spot, pseudomonas leaf spot and phytophthora root and stem rot as well as suppression of xanthomonas leaf spot and alternaria leaf spot on greenhouse and outdoor ornamentals, and to control anthracnose, brown patch and algae (green, blue-green) on turf.

BioSafe M-70 Hydrogen Peroxide Technical Bactericide/Fungicide (Registration Number 27431) and ZeroTol Broad-Spectrum Algaecide/Fungicide (Registration Number 29508) are conditionally registered in Canada. The detailed review for BioSafe M-70 Hydrogen Peroxide Technical Bactericide/Fungicide and ZeroTol Broad-Spectrum Algaecide/Fungicide can be found in Evaluation Report ERC2010-10, *Hydrogen Peroxide*. The current applications were submitted to convert BioSafe M-70 Hydrogen Peroxide Technical Bactericide/Fungicide and ZeroTol Broad-Spectrum Algaecide/Fungicide from conditional registration to full registration.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

This Overview describes the key points of the evaluation, while the Science Evaluation provides detailed technical information on the human health, environmental and value assessments of BioSafe M-70 Hydrogen Peroxide Technical Bactericide/Fungicide and ZeroTol Broad-Spectrum Algaecide/Fungicide.

What Does Health Canada Consider When Making a Registration Decision?

The key objective of the *Pest Control Products Act* is to prevent unacceptable risks to people and the environment from the use of pest control products. Health or environmental risk is considered acceptable[1] if there is reasonable certainty that no harm to human health, future generations or the environment will result from use or exposure to the product under its proposed conditions of registration. The Act also requires that products have value[2] when used according to the label directions. Conditions of registration may include special precautionary measures on the product label to further reduce risk.

To reach its decisions, the PMRA applies modern, rigorous risk-assessment methods and policies. These methods consider the unique characteristics of sensitive subpopulations in humans (for example, children) as well as organisms in the environment (for example, those most sensitive to environmental contaminants). These methods and policies also consider the nature of the effects observed and the uncertainties when predicting the impact of pesticides. For more information on how the PMRA regulates pesticides, the assessment process and risk-reduction programs, please visit the Pesticides and Pest Management portion of Health Canada's website at healthcanada.gc.ca/pmra.

Before making a final registration decision on hydrogen peroxide, the PMRA will consider all comments received from the public in response to this consultation document.[3] The PMRA will then publish a Registration Decision[4] on hydrogen peroxide, which will include the decision, the reasons for it, a summary of comments received on the proposed final registration decision and the PMRA's response to these comments.

For more details on the information presented in this Overview, please refer to the Science Evaluation of this consultation document.

What Is Hydrogen Peroxide?

Hydrogen peroxide is an oxidant, producing hydroxyl free radicals, which attacks thiol groups and double bonds of essential cell components such as lipids, proteins and DNA, inhibiting the growth of microorganisms. Hydrogen peroxide demonstrates broad-spectrum activities against fungi, bacteria and algae.

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1 "Acceptable risks" as defined by subsection 2(2) of the *Pest Control Products Act*.

2 "Value" as defined by subsection 2(1) of the *Pest Control Products Act*: "the product's actual or potential contribution to pest management, taking into account its conditions or proposed conditions of registration, and includes the product's (*a*) efficacy; (*b*) effect on host organisms in connection with which it is intended to be used; and (*c*) health, safety and environmental benefits and social and economic impact."

3 "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

4 "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Health Considerations

Can Approved Uses of Hydrogen Peroxide Affect Human Health?

Hydrogen peroxide is unlikely to affect your health when used according to label directions.

Potential exposure to hydrogen peroxide may occur when handling and applying the product. When assessing health risks, two key factors are considered: the levels where no health effects occur and the levels to which people may be exposed. Toxicology studies in laboratory animals describe potential health effects from varying levels of exposure to a chemical and identify the dose where no effects are observed. The dose levels used to assess risks are established to protect the most sensitive human population (for example, children and nursing mothers). Only uses for which the exposure is well below levels that cause no effects in animal testing are considered acceptable for registration.

Hydrogen peroxide is an oxidizing agent that is highly reactive and upon contact with moisture, degrades quickly to form water and oxygen. The body naturally produces hydrogen peroxide and detoxifying enzymes (for example, catalase and peroxidase) which control the amount of hydrogen peroxide in the body.

Technical grade hydrogen peroxide (90% concentration) is moderately toxic by the acute inhalation route in mice. At a concentration of 35%, it is considered to be severely irritating or corrosive to the eye and moderately irritating to the skin of rabbits. Consequently, the statements "Poison" and "Danger - Corrosive to eyes and skin" are required on the label. The end-use product ZeroTol Broad-Spectrum Algaecide/Fungicide is also of moderate toxicity when given as a single dose by the inhalation route to mice, and is corrosive to the eyes and moderately irritating to the skin of rabbits. Consequently, the statements "Poison" and "Danger – Corrosive to eyes and skin" are required on the label of the end-use product.

Hydrogen peroxide is a known mutagen when tested in vitro but is not genotoxic in vivo and did not cause cancer in animals. It is not expected that hydrogen peroxide would cause damage to the nervous system, have effects on reproduction, or have effects on the developing fetus. The first signs of toxicity in animals given daily doses of hydrogen peroxide over longer periods of time were decreased body weight gain and changes in blood parameters. However, after a single exposure the majority of effects observed will likely be due to the corrosive nature of hydrogen peroxide. The risk assessment protects against these effects by ensuring that the level of human exposure is well below the lowest dose at which these effects occurred in animal tests.

Risks in Residential and Other Non-Occupational Environments

Residential risks are not of concern when ZeroTol Broad-Spectrum Algaecide/Fungicide is used according to the proposed label directions

Given the rapid degradation and low residues of hydrogen peroxide expected after application, residues are not expected to remain on turf after application of this product and postapplication exposure to hydrogen peroxide is expected to be minimal following the application of ZeroTol Broad-Spectrum Algaecide/Fungicide.

Occupational Risks From Handling ZeroTol Broad-Spectrum Algaecide/Fungicide

Occupational risks are not of concern when ZeroTol Broad-Spectrum Algaecide/Fungicide is used according to the proposed label directions, which include protective measures.

Workers who mix, load or apply ZeroTol Broad-Spectrum Algaecide/Fungicide as well as workers re-entering freshly treated turf, nurseries and greenhouses can come in direct contact with ZeroTol Broad-Spectrum Algaecide/Fungicide residues on the skin or in the air. Therefore, the label specifies that anyone mixing/loading and applying ZeroTol Broad-Spectrum Algaecide/Fungicide must wear goggles or a face shield, coveralls over long-sleeved shirt and long pants, boots, chemical-resistant gloves, and a NIOSH-approved respirator. The label also requires that workers do not enter treated areas until residues have dried. Taking into consideration these label statements, the number of applications and the expectation of the exposure period for handlers and workers, the risk to these individuals are not a concern.

For bystanders, exposure is expected to be much less than that for workers and is considered negligible. Therefore, health risks to bystanders are not of concern.

Environmental Considerations

What Happens When Hydrogen Peroxide Is Introduced Into the Environment?

Once introduced to the environment hydrogen peroxide transforms rapidly to water and oxygen.

Hydrogen peroxide is expected to be highly mobile in terrestrial environments after application. Adsorption to soil particles is not expected. Due to its very short half-life of less than 1 hour in natural soils, movement in the terrestrial environment will be limited to very short distances and leaching to ground water is not expected. Hydrogen peroxide is expected to stay in solution in aquatic environments. Partitioning and accumulation in sediment is not expected. Aquatic half-lives have been observed to be one hour to ten days.

Bioaccumulation and biomagnification are not expected. Hydrogen peroxide is toxic to non-target aquatic organisms and potentially phytotoxic to non-target plants. Based on the use pattern and short half-lives in both terrestrial and aquatic habitats, exposure to birds, mammals and beneficial arthropods is not expected.

Value Considerations

What Is the Value of ZeroTol Broad-Spectrum Algaecide/Fungicide?

ZeroTol Broad-Spectrum Algaecide/Fungicide is a broad-spectrum antimicrobial for use on greenhouse surfaces and irrigation water treatment. ZeroTol Broad-Spectrum Algaecide/Fungicide contains hydrogen peroxide that will control or prevent the build up of fungi and algae on surfaces of greenhouse equipment and within the greenhouse irrigation waters, for example, flooded floors, flooded benches, recycled water systems, capillary mats, humidification and misting systems.

Furthermore, ZeroTol Broad-Spectrum Algaecide/Fungicide provides control of agricultural diseases, including rhizoctonia aerial blight, fusarium leaf spot, pseudomonas leaf spot and phytophthora root and stem rot as well as suppression of xanthomonas leaf spot and alternaria leaf spot on greenhouse and outdoor ornamentals. ZeroTol Broad-Spectrum Algaecide/Fungicide also controls anthracnose, brown patch and algae (green, blue-green) on turf.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law.

The key risk-reduction measures being proposed on the label of ZeroTol Broad-Spectrum Algaecide/Fungicide to address the potential risks identified in this assessment are as follows.

Key Risk-Reduction Measures

Human Health

Because there is a concern with users coming into direct contact with ZeroTol Broad-Spectrum Algaecide/Fungicide on the skin or through inhalation of spray mists, anyone mixing, loading and applying ZeroTol Broad-Spectrum Algaecide/Fungicide must wear goggles or a face shield, coveralls over long-sleeved shirt and long pants, boots, chemical-resistant gloves, and a NIOSH-approved respirator.

Environment

Buffer zones of 1 to 2 meters are required for the protection of freshwater and marine habitats.

Buffer zones of 1 meter are required for the protection of terrestrial habitats.

Environmental risk mitigation statements for the disposal of waste waters and effluent from industrial and greenhouse uses are also required.

Next Steps

Before making a final registration decision on hydrogen peroxide, the PMRA will consider all comments received from the public in response to this consultation document. The PMRA will accept written comments on this proposal up to 45 days from the date of publication of this document. Please forward all comments to Publications (contact information on the cover page of this document). The PMRA will then publish a Registration Decision, which will include its decision, the reasons for it, a summary of comments received on the proposed final decision and the Agency's response to these comments.

Other Information

When the PMRA makes its registration decision, it will publish a Registration Decision on hydrogen peroxide (based on the Science Evaluation of this consultation document). In addition, the test data referenced in this consultation document will be available for public inspection, upon application, in the PMRA's Reading Room (located in Ottawa).

Science Evaluation

Hydrogen Peroxide

1.0 The Active Ingredient, Its Properties and Uses

Please refer to Evaluation Report ERC2010-10, *Hydrogen Peroxide* for the active ingredient and its properties.

1.1 Directions for Use

ZeroTol Broad-Spectrum Algaecide/Fungicide is used for the prevention and control of fungi and algae on wood and non-porous hard surfaces and in irrigation waters (for use on non-food crops in greenhouses only) at concentrations between 3.3 mL and 20 mL per litre of clean water.

ZeroTol Broad-Spectrum Algaecide/Fungicide may also be applied as a foliar spray or a soil drench at 10 mL per litre of clean water for control or suppression of various fungal and bacterial diseases on greenhouse and outdoor ornamentals. Application rates of 190, 200 and 400 mL/100 m^2 are required for control of anthracnose, algae (green, blue-green) and brown patch on turf, respectively. Labelled spray volumes range between 11-19 L solution/100 m^2.

1.2 Mode of Action

Hydrogen peroxide is an oxidant, producing hydroxyl free radicals (OH), which attacks thiol groups and double bonds of essential cell components such as lipids, proteins and DNA. By reacting with these components, hydrogen peroxide interferes with the normal respiration process in susceptible pathogens, which ultimately leads to their death.

2.0 Methods of Analysis

Please refer to Evaluation Report ERC2010-10, *Hydrogen Peroxide* for methods of analysis.

3.0 Impact on Human and Animal Health

Please refer to Evaluation Report ERC2010-10, *Hydrogen Peroxide* for impact on human and animal health.

4.0 Impact on the Environment

Please refer to Evaluation Report ERC2010-10, *Hydrogen Peroxide* for impact on the environment.

4.1 Effects on Terrestrial Organisms

4.1.1 Terrestrial Vascular Plants

Vegetative Vigour
Granny smith apple trees, Asian pear trees, brooks cherry trees, fairtime peach trees, rhododendron, pittosporum, white rose, red rose, broccoli, cabbage, onion, garlic and cabbage crops were sprayed with Zerotol and Oxidate at a concentration of 0.27% g a.i./L at an application rate of 5524 g a.i./ha (per application) three times with an application interval of 1 day followed by an additional 3 applications with at a 7 day interval. The study authors reported that no phytotoxic effects were observed throughout the duration of the 24 day study.
The EC_{25} for phytotoxicity is therefore greater than the highest application rate tested (EC_{25} > 5524 g a.i./ha).

Seedling emergence
A study on the effects on hydrogen peroxide on seedling emergence was not reviewed nor required. Effects on seedling emergence of non-target vascular plants at the proposed application rate are not expected given the application rate and the very short half-life of hydrogen peroxide in natural soils of less than 1 hour. ZeroTol Broad-Spectrum Algaecide/Fungicide may in fact have the potential to improve seedling emergence of non-target terrestrial plants at the labeled rate as it is registered for the control of algae, fungi and bacteria on seedlings, seeds and seedbeds.

4.2.1 Risks to Terrestrial Organisms

Exposure of wild birds, mammals and beneficial arthropods as well as terrestrial plants to BioSafe M-70 Hydrogen Peroxide Technical Bactericide/Fungicide and the end-use product ZeroTol Broad-Spectrum Algaecide/Fungicide from use in greenhouses and in evaporative coolers is expected to be limited to the disposal of unused or unwanted product as well as from the cleaning of equipment and disposal of waste waters and effluent from greenhouses and industrial uses.

Exposure to wild birds, mammals and beneficial arthropods to ZeroTol Broad-Spectrum Algaecide/Fungicide from the use on turf and outdoor ornamentals is expected to be limited and it is expected that the proposed use pattern will not result in an unacceptable risk to these organisms. Hydrogen peroxide is a contact algaecide/fungicide. Dried residues on food sources for wild birds, mammals and beneficial arthropods are expected to be negligible due to the short half-life. Dried residues on foliage are also expected to be negligible. Hydrogen peroxide is naturally occurring, does not persist and is not expected to bioaccumulate. Hydrogen peroxide is also produced naturally in honey by the enzyme glucose oxidase, which itself is produced by honey bees.

Terrestrial vascular plants can be exposed to hydrogen peroxide from drift following the application of ZeroTol Broad-Spectrum Algaecide/Fungicide to turf and outdoor ornamentals.

To assess the potential effects from exposure to hydrogen peroxide to non-target terrestrial plants, screening level estimated environmental concentrations were based on direct over-spray at the labeled application rate. The slowest reported half-life for hydrogen peroxide in soil was 0.04 days. In those cases where the screening level assessments resulted in a risk to the non-target organism, a refined assessment was conducted to further characterize the risk resulting from drift. The calculated screening level risk quotients are summarised in Appendix I, Table 2. The refined risk quotients are summarised in Appendix I, Table 3. The refined risk characterization indicated that spray drift of hydrogen peroxide will not result in an unacceptable risk to non-target terrestrial plants.

5.0 Value

5.1 Effectiveness Against Pests

5.1.1 Acceptable Efficacy Claims

Data from several laboratory and field trials carried out with a variety of surfaces were submitted, as well as data for water treatment. These studies demonstrated the antimicrobial properties of ZeroTol Broad-Spectrum Algaecide/Fungicide against various fungi and algae in the different setups.

To assess agricultural and turf claims, 20 efficacy studies were reviewed, including 12 trials designed to fulfill value requirements previously established by the PMRA. Studies were conducted under growth chamber, greenhouse or field conditions. Tested crops included: Boston fern, dracaena, English ivy, impatiens, lilac, ornamental kale, rhododendron, scarlet runner bean, schefflera, vinca, zebra plant, zinnia and turf. ZeroTol Broad-Spectrum Algaecide/Fungicide suppressed or controlled the following fungal and bacterial diseases on ornamental plants: rhizoctonia aerial blight, fusarium leaf spot, pseudomonas leaf spot, phytophthora stem and root rot, xanthomonas leaf spot and alternaria leaf spot. Moreover, the end-use product adequately controlled anthracnose, brown patch and algae (green, blue-green) on turf.

5.2 Non-Safety Adverse Effects

No phytotoxic reactions were reported in any of the trials.

5.3 Economics

No economic analysis was performed.

5.4 Sustainability

5.4.1 Survey of Alternatives

There are four other products currently registered specifically for greenhouse surfaces (see Appendix I, Table 4). No product is currently registered to treat the irrigation water in greenhouses.

Several active ingredients with different modes of action are registered for use on turf. However, a limited number of fungicide products are currently registered for use against rhizoctonia aerial blight, fusarium leaf spot, pseudomonas leaf spot, xanthomonas leaf spot and alternaria leaf spot on greenhouse and outdoor ornamentals. Refer to Appendix I, Table 5 for a summary of the active ingredients currently registered for the uses supported with ZeroTol Broad-Spectrum Algaecide/Fungicide.

5.4.2 Compatibility with Current Management Practices Including Integrated Pest Management

No information was provided.

5.4.3 Information on the Occurrence or Possible Occurrence of the Development of Resistance

Because of the immediate nature of the chemical interaction between hydrogen peroxide and the pathogens, there is little chance of mutations occurring, which greatly reduces the risk for resistance development. Hydrogen peroxide is currently not listed by the Fungicide Resistance Action Committee, and no recommendations are specified for resistance management.

5.4.4 Contribution to Risk Reduction and Sustainability

The registration of ZeroTol Broad-Spectrum Algaecide/Fungicide provides growers with an alternative mode of action to manage certain fungal and bacterial diseases on ornamentals and turf. Its integration in spray programs may contribute to risk reduction and delay resistance development in sensitive pathogens by reducing the need for higher risk fungicides.

6.0 Pest Control Product Policy Considerations

Please refer to Evaluation Report ERC2010-10, *Hydrogen Peroxide* for pest control product policy considerations.

7.0 Summary

7.1 Human Health and Safety

For the summary of human health and safety refer to Evaluation Report ERC2010-10, *Hydrogen Peroxide*, Section 7.1.

7.2 Environmental Risk

Hydrogen peroxide is not persistent in natural soils or natural aquatic environments. Leeching is expected to occur only over short distances and hydrogen peroxide is not expected to leech to groundwater. Volatilization and long range transport are not expected. Accumulation and carry over are not expected. Without risk-reduction measures, hydrogen peroxide may impact non-target terrestrial plants and non-target aquatic organisms.

Based on the proposed use pattern and short half-life, hydrogen peroxide is not expected to pose an unacceptable risk to birds, mammals, beneficial arthropods, non-target terrestrial plants and aquatic organisms. Hydrogen peroxide can enter aquatic environments through spray drift and disposal of waste waters and unused/unwanted product as well as terrestrial habitats through spray drift. Risks to algae, amphibians and non-target terrestrial plants were identified at the screening level as a result spray buffer zones and label statements are required.

7.3 Value

The studies submitted in support of ZeroTol Broad-Spectrum Algaecide/Fungicide demonstrated its value as an algaecide/fungicide for use on greenhouse surfaces and irrigation waters. The availability of ZeroTol Broad-Spectrum Algaecide/Fungicide will provide the industry with a new product to address algae and fungi problems in greenhouses.

The data submitted to register ZeroTol Broad-Spectrum Algaecide/Fungicide also demonstrated that it will control rhizoctonia aerial blight, fusarium leaf spot, pseudomonas leaf spot, phytophthora root and stem rot as well as suppress xanthomonas leaf spot and alternaria leaf spot on greenhouse and outdoor ornamentals. In addition, ZeroTol Broad-Spectrum Algaecide/Fungicide adequately controlled anthracnose, brown patch and algae (green, blue-green) on turf.

The registration of ZeroTol Broad-Spectrum Algaecide/Fungicide provides growers with an alternative mode of action to manage certain fungal and bacterial diseases, especially on ornamentals, where a limited number of fungicide products are currently registered. Its integration in spray programs may contribute to risk reduction and delay resistance development in sensitive pathogens by reducing the need for higher risk fungicides.

8.0 Proposed Regulatory Decision

Health Canada's PMRA, under the authority of the *Pest Control Products Act* and Regulations, is proposing full registration for the sale and use of BioSafe M-70 Hydrogen Peroxide Technical Bactericide/Fungicide and ZeroTol Broad-Spectrum Algaecide/Fungicide, containing the technical grade active ingredient hydrogen peroxide, to control or prevent the buildup of fungi and algae on surfaces of greenhouse equipment and within the greenhouse irrigation waters, for the control of agricultural diseases, including rhizoctonia aerial blight, fusarium leaf spot, pseudomonas leaf spot and phytophthora root and stem rot as well as suppression of xanthomonas leaf spot and alternaria leaf spot on greenhouse and outdoor ornamentals, and to control anthracnose, brown patch and algae (green, blue-green) on turf.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

List of Abbreviations

a.i.	active ingredient
DACO	Data Code
DNA	deoxyribonucleic acid
EC_{25}	effective concentration on 25% of the population
EEC	Expected environmental concentration
g	gram
ha	hectare(s)
L	litre
m^2	metre(s) squared
mL	millilitre
NIOSH	National Institute for Occupational Safety and Health
PMRA	Pest Management Regulatory Agency
ppm	parts per million
RQ	risk quotient
USC	Use Site Category
USEPA	United States Environmental Protection Agency

Appendix I Tables and Figures

Table 1 Toxicity to Non-Target Species

Organism	Exposure	Endpoint value	Degree of toxicity[a]
Terrestrial species			
Apple trees, pear trees, cherry trees, peach trees, Rhododendron, Pittosporum, white rose, red rose, broccoli, cabbage, onion, and garlic.	24 day Phytotoxicity	EC_{25} > 5524 g a.i./ha	

[a] USEPA classification, where applicable

Table 2 Screening Level Risk Assessment on Non-target Species

Organism	Exposure	Endpoint value (g a.i. /ha)	EEC (g a.i. /ha)	RQ	Level of Concern Exceeded
Terrestrial species					
Apple trees, pear trees, cherry trees, peach trees, Rhododendron, Pittosporum, white rose, red rose, broccoli, cabbage, onion, and garlic.	24 day Phytotoxicity	EC_{25} > 5524 g a.i./ha	11783	2.1	Yes

Table 3 Refined Risk Assessment on Non-Target Species

Organism	Exposure	Endpoint value (g a.i. /ha)	EEC (g a.i. /ha)	RQ	Level of Concern Exceeded
Terrestrial species					
Apple trees, pear trees, cherry trees, peach trees, Rhododendron, Pittosporum, white rose, red rose, broccoli, cabbage, onion, and garlic.	24 day Phytotoxicity	EC_{25} > 5524 g a.i./ha	707	0.1	No

Table 4 Summary of Pest Control Alternatives for the Uses Supported on Greenhouse Surfaces with ZeroTol Broad-Spectrum Algaecide/Fungicide

Products registered	Registration Number	Active ingredients	Label claims
Floralife Formula	20397	n-Alkyl (40% C12, 50% C14, 10% C16) dimethyl benzyl ammonium chloride at 5.0%	Greenhouse or agricultural hard-surfaces use.
Effersan	25087	Sodium dichloro-s-triazinetrione 30%	
Aquarian M390	28785	Didecyl dimethyl ammonium chloride at 7.5%	Greenhouse floors, walkways, benches, horticultural equipment, footbaths, walls, ceilings
Kleengrow	13148		

Table 5 Summary of Fungicide Alternatives for the Uses Supported with ZeroTol Broad-Spectrum Algaecide/Fungicide*

Claim	Active Ingredient and Resistance Management Group
rhizoctonia acrial blight / ornamentals	Greenhouse (USC #6)
	- chlorothalonil (M5)
	Outdoors (USC #27)
	- chlorothalonil (M5)
fusarium leaf spot / ornamentals	Greenhouse (USC #6)
	- chlorothalonil (M5)
	Outdoors (USC #27)
	- chlorothalonil (M5)
pseudomonas leaf spot / ornamentals	Greenhouse (USC #6)
	- *Bacillus subtilis* QST 713 (44)
	Outdoors (USC #27)
	- *Bacillus subtilis* QST 713 (44)

phytophthora stem and root rot / ornamentals	Greenhouse (USC #6)
	- metalaxyl-M and S-isomer (4) - etridiazole (14) - propamocarb hydrochloride (28) - fosetyl-Al (33) - mono- and dibasic sodium, potassium, and ammonium phosphites - *Bacillus subtilis* QST 713 (44) - chlorothalonil (M5) - *Gliocladium catenulatum* J1446 - *Streptomyces* K61
	Outdoors (USC #27)
	- metalaxyl-M and S-isomer (4) - etridiazole (14) - propamocarb hydrochloride (28) - fosetyl-Al (33) - mono- and dibasic sodium, potassium, and ammonium phosphites - fluopicolide (43) - *Bacillus subtilis* QST 713 (44) - chlorothalonil (M5) - *Trichoderma harzianum* Rifai KRL-AG2
xanthomonas leaf spot / ornamentals	Greenhouse (USC #6)
	- *Bacillus subtilis* QST 713 (44) - copper (M1)
	Outdoors (USC #27)
	- *Bacillus subtilis* QST 713 (44)
alternaria leaf spot / ornamentals	Greenhouse (USC #6)
	- copper (M1) - chlorothalonil (M5)
	Outdoors (USC #27)
	- folpet (M4) - chlorothalonil (M5)

anthracnose / turf	- propiconazole (3) - penthiopyrad (7) - azoxystrobin (11) - pyraclostrobin (11) - trifloxystrobin (11) - fosetyl-Al (33) - *Bacillus subtilis* QST 713 (44) - chlorothalonil (M5)
brown patch / turf	- thiophanate-methyl (1) - iprodione (2) - myclobutanil (3) - propiconazole (3) - penthiopyrad (7) - azoxystrobin (11) - pyraclostrobin (11) - trifloxystrobin (11) - *Bacillus subtilis* QST 713 (44) - captan (M4) - chlorothalonil (M5)
algae (blue, blue-green) / turf	- iron (present as FeHEDTA)

* Certain active ingredients are registered on specific ornamental crops only.

Table 6 Use (label) Claims Proposed by Applicant and Whether Acceptable or Unsupported

Proposed claims	Supported / Unsupported
Spray or foam at 3.3-20 mL product/L water on non-porous surfaces and wood in greenhouse structures.	Supported.
Apply with irrigation waters at 0.1-0.33 mL product/L water. Use the higher concentration for water with heavy organic load. For use on non-food crops in greenhouses only.	Supported.
Greenhouse and outdoor ornamentals: control of aerial blight (*Rhizoctonia* spp.) and fusarium leaf spot (*Fusarium* spp.) with 3 foliar applications at 7-day intervals. Apply 10 mL product/L water, 11-19 L solution/100 m^2.	Supported.
Greenhouse and outdoor ornamentals: suppression of xanthomonas leaf spot (*Xanthomonas* spp.) and alternaria leaf spot (*Alternaria* spp.) with 3 foliar applications at 7-day intervals. Apply 10 mL product/L water, 11-19 L solution/100 m^2.	Supported.

Greenhouse and outdoor ornamentals: suppression of pseudomonas leaf spot (*Pseudomonas* spp.) with 5 foliar applications at 7-day intervals. Apply 10 mL product/ L water until run-off.	Supported.
Greenhouse and outdoor ornamentals: suppression of phytophthora root and stem rot (*Phytophthora* spp.) with 5 drench and/or foliar applications at 7-day intervals. Apply 10 mL product/ L water until run-off.	Drench applications supported.
Turf: control of anthracnose (*Colletotrichum graminicola*) with 5 foliar applications at 7-day intervals. Apply 190 mL product/11-19 L water/100 m^2.	Supported.
Turf: control of brown patch (*Rhizoctonia solani*) with 5 foliar applications at 7-day intervals. Apply 400 mL product/11-19 L water/100 m^2.	Supported.
Turf: control of green and blue-green algae with 5 foliar applications at 7-day intervals. Apply 200 mL product/11-19 L water/100 m^2.	Supported.

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A. List of Studies/Information Submitted by Registrant

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